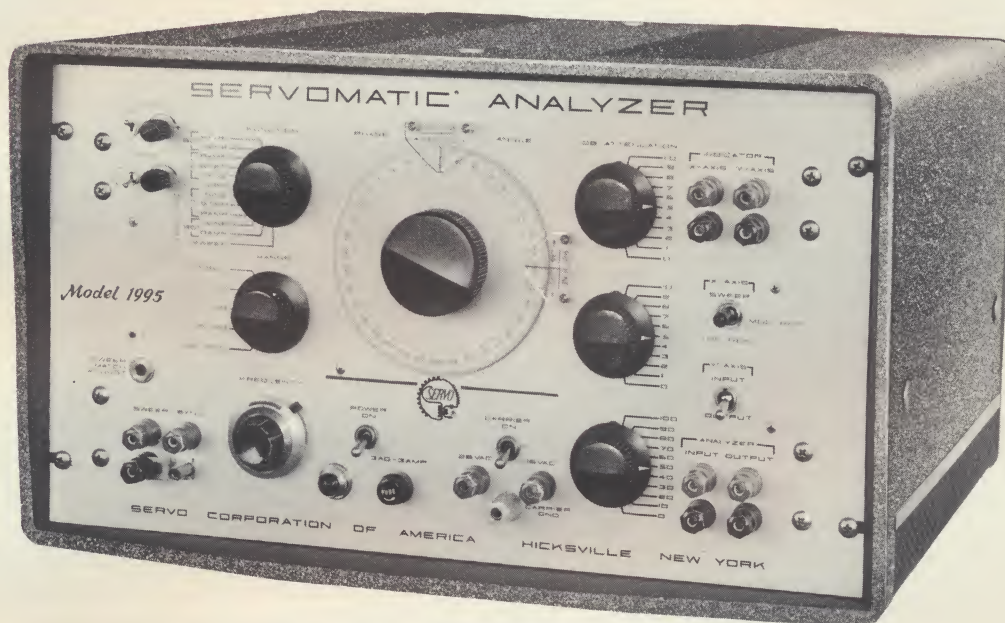


REPRESENTED BY
TESCO ASSOCIATES
114 MILES AVE., SYRACUSE 10, N. Y.
TED A. HENDEL, Field Engineer
GRanite 4-3291

SERVOMATIC[®] ANALYZER

SERIES 1900

new, improved waveform containing less than 1% distortion.



Model 1995 with DC offset and internal modulation

The Model 1995 Servomatic Analyzer provides in a single package an instrument for testing servo systems which is **FAST**, **RELIABLE**, and **EASY TO USE**. It combines the capabilities of a Function Generator, Variable Phase Reference, Internal Modulator, and Precision db Attenuator.

The Model 1995 is a precision instrument providing direct amplitude and frequency readings. All outputs can be generated either unmodulated or carrier modulated. The newer features of **DC OFFSET**, **INTERNAL MODULATION** and **LOWER DISTORTION** provide for even greater operational ease.

The equipment is highly reliable being all electronic and employing printed circuit construction.

ANALOG/DIGITAL PRODUCTS DIVISION.

SERVO CORPORATION OF AMERICA

111 NEW SOUTH ROAD, HICKSVILLE, L. I., N. Y.



The diagram illustrates a closed-loop servo system. At the top, a **SERVO ANALYZER** is connected to a **SERVOSCOPE INDICATOR**. The Servo Analyzer has several input and output ports. A **SERVO POWER LINE** is connected to its input. An **INSTRUMENT PICK-OFF (MECHANICAL INPUT)** is connected to its input. A **CARRIER (50-10 Kc)** is connected to its input. The Servo Analyzer has an **OUTPUT OF SERVO ANALYZER** connected to the Servoscope Indicator. The Servo Analyzer is also connected to a **GEAR TRAIN**, which produces a **MECHANICAL OUTPUT**. The Gear Train is connected to a **SERVO MOTOR** via an **A.C. TACH.** (A.C. Tachometer). The Servo Motor is connected to the **SERVO AMPLIFIER**. The Servo Amplifier is connected to the **SERVO POWER LINE** and the **GEAR TRAIN**. The Servo Amplifier is also connected to the **SERVOSCOPE INDICATOR**.

model 1995 specifications

Frequency range	.005-1000 cps, continuously variable in five ranges for all waveforms.
Frequency calibration accuracy	$\pm 2\%$ max. of dial setting.
Available signal outputs:	
0° and 90° sine wave	0-40V, p-p min.
Total harmonic distortion (90°)	Less than 1%.
Square wave	0-40, p-p min.
0° and 90° triangular wave	0-35V, p-p min.
(All waveforms can be modulated)	
Synchronized sweep	7V min.
Sync pulse	6V pos.; 12V neg.
DC Offset	$\pm 5V$ min.
Carrier acceptance	50-10,000 cps (external); 1 watt, 26V/115V terminals provided.
Output impedance	600 ohms over entire range.
Phase measurement	0-360° dial; 0° and 90° reference points.
Phase accuracy	$\pm 2\%$.
Internal Modulation (Bow-tie)	100 KC.
Attenuator accuracy	$\pm 2\%$ (at 600 ohm load).
Power requirements	115V, 50/60 cps; 250W. 230V, 50/60 cps, with minor modification.

Front panel switches and adjustments: Frequency, 5 position range switch and direct reading calibrated vernier dial. Direct reading amplitude in db with three decade attenuators. 0-360° direct reading phase dial. "X" axis switch to select sweep, D C reference or internal modulated reference as horizontal input to a CRT indicator. "Y" axis switch to display either input to system under test or output of that system.

SIZE AND WEIGHT:

(Approx. the same for all models)

	H	W	D	WGT
Rack mount	10½"	19"	15½"	40#
With cabinet	12"	20"	18"	45#
With CRT indicator and cabinet	22½"	20"	18"	85#

servomatic analyzer/ model 1990



For those applications where the DC offset and internal modulation are not required, Servo Corporation offers the Model 1990, at considerable savings. All other specifications remain the same as the Model 1995, and Servo's same high-quality engineering standards prevail throughout.

Specifications same as model 1995 less DC Offset and Internal Modulation (Bow-tie)

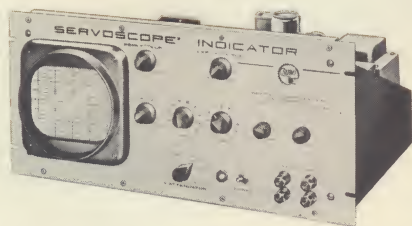
servomatic analyzer/ model 1980



This is the most reasonably priced DC servo analyzer available. It combines simplicity, versatility, and flexibility, for use in all forms of feed-back analysis.

Specifications same as model 1995 less DC Offset and Internal Modulation (Bow-tie). Variable Attenuator and 10X Multiplier is substituted for direct reading decade attenuators.

servoscope® indicator/ model 1103



This unit is a highly stable indicator for use with any of the Servomatic Analyzer models. The five inch, long persistence, high resolution cathode ray tube permits very sharp photographs. Incorporated are the associated power supply and directly coupled deflection amplifiers. An information grid to facilitate amplitude measurements is located over the face of the cathode ray tube.

model 1103 specifications

Sensitivity	Vertical: 34 mv/inch D C Response ± 3 db, D C to 20 Kc. Horizontal: 1.2 V/inch D.C. Response ± 3 db, D C to 150 Kc.
Phase Shift	Negligible for servo carriers.
Intensity and Focus ..	Adjustments on front panel.
Astigmatism	Adjustments on chassis.
Position and Gain	Controls for X and Y axis.
Balance	Control for Y axis.
Attenuation	By factors of 1, 10, 100 or 1000 $\pm 1\%$ as selected by Y attenuator.
Expansion	Four times full screen diameter.
Transient Response ...	Rise time—3 microseconds or less overshoot 2% or less.
Low Drift	and excellent stability throughout the servo carrier frequency range.

how to use the servomatic analyzer

By measuring the relative amplitude of the output and input patterns and taking simultaneous phase readings, sufficient data is obtained to plot a phase and amplitude characteristic on the complex plane (Nyquist diagram) of the servo system or component. The data may also be used to plot a log amplitude—log frequency curve (Bode diagram) or a log amplitude—phase diagram (Nichols diagram).

measuring phase

a.c. servo systems

The modulated carrier signal is generally used to test A C servo systems. A saw-tooth sweep, generated and synchronized with the output signal, is applied to the oscilloscope horizontal (X) axis, and serves as a time base. When the modulated signal (Servomatic output) is applied to vertical (Y) axis, a reference pattern is produced. See Figure A. However, when the system response (Servomatic input) is applied to the vertical axis in place of the signal, any difference in phase will appear as a shift along the X axis. See Figure B. The system phase shift can be viewed from this display.

As a preferred method of measurement, however, the engineer may make use of the Lissajous pattern. This is obtained by applying the sinusoidal reference signal, in place of the sweep, to the oscilloscope horizontal (X) axis. When the phase shift is zero, the pattern will take the form of a "Bow-Tie" with pin-point cross-over. See Figure C. As the control system under test introduces a phase shift, the pattern assumes an expanding elliptical shape until it shows a circle pattern at 90° shift. See Figure D. For 90° to 180° phase shift, the pattern collapses into an ellipse and finally returns to the "Bow-Tie".

d.c. servo systems

The sine wave signal is generally used to test D C systems. The system response is applied to the oscilloscope vertical (Y) axis.

The sweep may be applied to the oscilloscope horizontal (X) axis. The resulting pattern would be a sine wave. See Figure E. However, with this pattern, it is difficult to accurately measure phase shift as the dial is rotated. Therefore, the sinusoidal modulated reference signal is usually applied to the X axis instead. Figure F shows the resulting pattern of zero phase shift. As the phase shift increases, the crossover point separates until, at 45° phase shift, it shows the pattern in Figure G. Figure H shows the pattern at 90° phase shift.

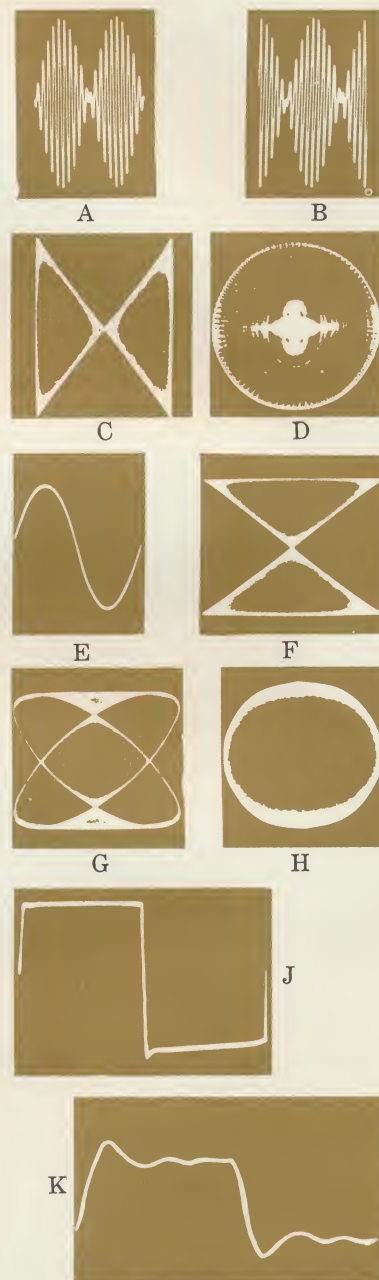
In order to determine the phase lead or lag, the phase dial is rotated until the response pattern duplicates zero phase shift. Since the phase dial has actually shifted the signal an amount equal and opposite to the phase shift in the system, the phase lead or lag is obtained by reading the calibrated dial directly.

measuring gain

By measuring the relative amplitude of the pattern or by using the db attenuator (with a 600-ohm load) and taking simultaneous phase readings over the proper frequency range, sufficient data may be readily taken to plot a phase and amplitude characteristic of the servo system or component.

transient response

The square wave signal, representing a series of positive and negative step functions, is generally used to obtain transient-response information. The sweep, synchronized with the signal, is applied to the oscilloscope horizontal (X) axis. See Figure J. When the response of a D C system is applied to vertical axis, the pattern will take a form similar to Figure K, depending on the damping factor of the system under test. Overshoot, response time, rise time, settling time may be determined from such patterns.



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Domestic Price List for 1900 Series SERVOMATIC® Analyzer
Subject to Change Without Notice
FOB Hicksville, New York

<u>MODEL</u>	<u>DESCRIPTION</u>	<u>PRICE</u>
1980	SERVOMATIC® Analyzer .005 to 1,000 cps, unmodulated waveforms	\$2,355.00
1980R	SERVOMATIC® Analyzer same as 1980 for rack mounting	2,320.00
1980X	SERVOMATIC® Analyzer Model 1980 with CR Indicator Model 1103	3,075.00
1990	SERVOMATIC® Analyzer .005 to 1,000 cps, modulated and unmodulated waveforms	2,850.00
1990R	SERVOMATIC® Analyzer same as 1990 for rack mounting	2,815.00
1990X	SERVOMATIC® Analyzer Model 1990 with CR Indicator Model 1103	3,570.00
1995	SERVOMATIC® Analyzer .005 to 1,000 cps modulated and unmodulated waveforms plus DC offset and internal self- generated modulated reference.	3,275.00
1995R	SERVOMATIC® Analyzer Rack mount	3,240.00
1995X	SERVOMATIC® Analyzer same as 1995 with Cathode Ray Indicator Model 1103	3,995.00

December 15, 1965

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